Belinda Storey and Ilan Noy

Insuring Property under Climate Change

Climate change will increasingly create severe risks for New Zealand's coastal housing stock. Even a small amount of sea level rise will substantially exacerbate the costs of flooding and storm surges (Parliamentary Commissioner for the Environment, 2015). Under the Intergovernmental Panel on Climate Change's (IPCC) three mitigation scenarios, global average sea levels are likely to rise by between 28cm and 73cm by 2100 (above the 1986–2005 average). Under the IPCC's high emissions scenario the sea level is likely to rise by between 52cm and 98cm by 2100 (IPCC, 2013). Only collapse of parts of the Antarctic ice sheet, if triggered, could cause the sea level to rise substantially above these ranges. Some regions in New Zealand (including the main urban centres) have high enough quality geographic data to infer the number of homes at risk. In those regions, there are over 43,000 homes within 1.5m of the present average spring high tide and over 8,000 within 50cm (Bell, Paulik and Wadwha, 2015).

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In the best of all possible worlds New Zealand would face far fewer risks from climate change. Sound science would communicate future risk, which would be understood by all decision makers. These decision makers would make socially optimal decisions and would coordinate across all levels and parts of government. Existing homeowners would take risk into account when making housing investment decisions. Home buyers would take risk into account when purchasing, and this would affect both what they purchase and how much they are willing to pay. Developers would take future and current climate risk into account in siting and designing developments. Insurers would pool the residual risk across individuals, and would obtain affordable reinsurance in international markets. Councils would credibly commit to an adaptive decision-making approach for land use and building decisions and would continue to adjust this approach as the climate, and sea level, change. Alas, we do not live in this Panglossian dream.

In reality, there is limited information about how climate risks will change over time and the information that is available is often not accessible to the layperson.

Even with good information, people often make poor decisions under different types of uncertainty: they overreact to small threats, easily forget previously observed loss, and exhibit optimism bias when risks are high. They often discount future events heavily and do not plan well for them.[1] These same obstacles and barriers faced by homeowners and renters also afflict, of course, policymakers, and the employees of private sector entities involved in residential housing, such as banks and insurers.

When coastal disasters occur, homeowners experience significant losses and displacement. Some may be forced to permanently leave their community after a single and sudden-onset disaster like a storm surge, flash flood or landslide, or following a series of smaller events that accumulate to large losses (Moftakhari et al., 2017). Property developers and existing homeowners may seek to block the transmission of information about risk to potential home buyers. Local and central government may face high costs from protective measures and continued provision of infrastructure when abandoning housing may be more efficient. Local authorities, and their insurers, may find themselves holding unexpected liabilities if future courts rule that councils are liable for resource consents provided to homes threatened by climate change. All this may happen, and almost surely will.

Climate change will render some currently inhabited locations uninhabitable. This transition could well be costly for individuals and their communities. It is not yet known how many locations will face this transition over the next few decades. Many of the costs considered in this article will be accrued in the more distant future. The traditional use of government discount rates might portray such costs several decades from now as innocuous. Heavily discounting the future losses from past and present actions is generally inappropriate, however, especially when those harmed will be uncompensated (Cowen and Parfit, 1992; Stern, 2015). Moreover, discounting is incongruous with the emphasis within mātauranga Māori on safeguarding treasures that have been passed down by past generations (Awatere, 2008). The assets which will be exposed to climate change decades hence are being built now, so the far-reaching consequences of current decisions should be reflected in current policy (Stephens, Bell and Lawrence, 2017).

Here, we focus on how escalating coastal housing risks induced by sea level rise, coastal storms and extreme precipitation will affect the future availability of insurance in New Zealand. Insurance does not reduce risk. Instead, insurance allows one party (the insured) to transfer some of its risk to another party (the insurer) through a financial contract which compensates the insurer for the receipt of the transferred risk. Evidence from international markets suggests that when a risk is perceived to have increased and become unprofitable to transfer, insurance companies classify affected areas as 'uninsurable' and withdraw insurance altogether. The New Zealand government plays a major role in the provision of some natural disaster insurance through the Earthquake Commission (EQC). Several other features differentiate the New Zealand residential property insurance sector from those in other countries. First, New Zealand has mostly international insurers in the local market. Second, disaster insurance take-up is unusually high (probably around 90-95%), because it is automatically attached to fire insurance. Third, prudential regulation of New Zealand insurers is quite recent and does not constrain the product categories in which an insurer may operate (Dean, 2010). Fourth, the New Zealand insurance industry has historically offered all-perils coverage, including major natural hazards such as earthquakes and floods that are often excluded elsewhere.

Other institutions are also used to manage risk. *The New Zealand Coastal Policy Statement 2010*, established under the Resource Management Act (RMA), is the overarching planning document regarding New Zealand's coasts along with part 2 matters in the RMA. Each regional council is required to prepare a regional coastal policy statement which outlines how, among other matters, the regional council addresses management of natural hazards (including climate change) and must give effect to the national policy. *The New Zealand Coastal Policy Statement* states that a pre-cautionary approach should be adopted to resource use and development in coastal environments wherever the effects of activities 'are uncertain, unknown, or little understood, but potentially significantly adverse' (policy 3). It highlights climate change as a particularly important source of vulnerability for coastal resources and outlines policies for identifying and managing coastal hazards, including the effects of climate change (policies 24–27) (Department of Conservation, 2010). Local councils are responsible for managing risk insofar as they construct infrastructure and make planning decisions which affect exposure to coastal hazards.

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Issues with pricing climate-sensitive insurance

Climate change may make the calculation of actuarially precise premiums more difficult as changes to hazard frequency and intensity render historical data less relevant. In recent decades most of the increase in global coastal risk has

come from increased exposure through urbanisation and economic development (McGranahan, Balk and Anderson, 2007). However, as the sea level rises at faster rates, and storms intensify, changes in hazards are expected to replace changes in exposure as the primary driver of escalating coastal risks (Prudential Regulation Authority, 2015).

As the global sea level rises, king tides, storm surges and waves will reach further inland. Research commissioned by the Parliamentary Commissioner for the Environment has demonstrated that even modest increases in the sea level will dramatically reduce the return period of major events. For example, with a 10cm sea level rise the return period for a one-in-100-year storm surge in Wellington will reduce by a factor of five to a return period of one in 20 years. Once the sea level has risen by 30cm, a one-in-100-year event is expected to become an annual event in Christchurch and Wellington. The global sea level is projected to rise by between 17 and 38cm by 2065 (IPCC, 2013).

The resolution of climate models is such that it is difficult to predict even large events such as tropical cyclones (Roberts, Colle and Korfe, 2017; Walsh et al., 2015). Nevertheless, most climate models predict that while the number of tropical cyclones in the South Pacific will reduce slightly, the proportion of tropical cyclones that reach category 4 and 5 will increase and the path of tropical cyclones will move poleward (Holland and Bruyere, 2014; Kossin, Emanuel and Vecchi, 2014; Munich Re, 2016; Ramsay, Camargo and Daehyun, 2014; Woodruff, Irish and Camargo, 2013). This could increase the probability that a tropical cyclone undergoes an extratropical transition that results in a large storm surge in Auckland or Tauranga, where many exposed homes and businesses are located.

Accurate estimates of future coastal hazards are further limited by deep uncertainties around polar ice sheet response and future global emission pathways, the high collection cost of up-to-date high-resolution land elevation and asset data sets, and the limited precision of risk models for extreme events and their actuarial counterparts.

The price New Zealand pays for reinsurance in global financial markets is an important determinant of the retail cost of insurance. If international reinsurance markets harden – currently they are facing historically low costs of financing – the reinsurance premiums paid by EQC and New Zealand's private insurers could significantly rise. Since New Zealand catastrophic risk is uncorrelated with other markets, reinsurers are more likely to raise prices than to leave the New Zealand market altogether, but reinsurers may ultimately withdraw cover for some perils, such as storm surges or earthquakes.

> International experience suggests that in the absence of an EQC-type scheme, most homeowners do not insure against natural hazards and governments are compelled by public pressure to provide ad hoc assistance

Demand for residential insurance

Even risk-averse individuals tend to underestimate risk, particularly low-probability, high-impact risk (Kousky, Michel-Kerjan and Raschky, 2017; Kunreuther and Pauly, 2004; McClelland, Schulze and Coursey, 1993). Demand for insurance often increases immediately following a catastrophic event (Browne and Hoyt, 2000; Michel-Kerjan and Kousky, 2010), but returns to modest levels within a few years (Gallagher, 2014). In locations that have not experienced an event for a number of years, or where the average household tenure at that location is short, the demand for catastrophic insurance is likely to be subdued.

International studies have found that the demand for insurance cover for catastrophic events is more price sensitive than for insurance for non-catastrophic events (Botzen and van den Bergh, 2012; Grace, Klein and Kleindorfer, 2004). When insurance premiums for low-probability events rise in price, individuals may stop insuring or may under-insure, even when those premiums are subsidised below their true actuarial cost (Dixon at el., 2006; Petrolia, Landry and Coble, 2013). Those with lower incomes are somewhat less likely to buy catastrophic insurance than those with higher incomes (Grace, Klein and Kleindorfer, 2004).

The combined effect of price and income means that as insurance premiums consume a greater proportion of disposable income, homeowners are less likely to retain insurance (Landry and Jahan-Parvar, 2011) and demand for insurance falls faster for lower-probability, high-impact risk (i.e. the risk from catastrophic events) than it does for higher-probability, low-impact risk (i.e. frequent nuisance events) (Grace, Klein and Kleindorfer, 2004). In other words, if the AEP (annual exceedance probability) of an event doubles from 0.5% to 1% (i.e. if a one-in-200-year event becomes a one-in-100-year event), insurance demand is likely to fall by a greater amount than if the AEP doubles from 2% to 4% (i.e. if a one-in-50-year event becomes a one-in-25-year event).

The Household Economic Survey conducted by Statistics New Zealand suggests that average household expenditure on building insurance has almost doubled since the first Canterbury earthquake in 2010, from $540 in 2010 to $1,051 in 2015 (New Zealand Treasury, 2017). This includes the 2012 increase in EQC premium rates from 5 cents to 15 cents per $100 cover, but not the November 2017 increase to 20 cents. As insurance premiums take up a larger proportion of disposable income, more low-income households are likely to under-insure or allow their insurance policies to lapse.

Homeowners may not purchase insurance if they believe that they will be compensated by government. International experience suggests that in the absence of an EQC-type scheme, most homeowners do not insure against natural hazards and governments are compelled by public pressure to provide ad hoc assistance (Kousky, Michel-Kerjan and Raschky, 2017; Kunreuther and Michel-Kerjan, 2014). This may encourage homeowners to avoid insurance, thereby increasing the future fiscal risk for government if it is induced to provide compensation (Raschky and Weck-Hannemann, 2007; Raschky et al., 2013).

Following the Canterbury earthquakes, the government did not assist homeowners who had not purchased insurance except where it was compelled to do so for property that was red-zoned.[2] Any public objection to that decision was muted, as the number of people who reportedly did not have insurance was very small. Public objection and government response after a climate change-related disaster may be very different if the number of uninsured properties is higher where insurance had previously been prohibitively priced for affected communities, or if the event is perceived to be at least partially a consequence of government failure.

Case study: Edgecumbe and Cyclone Debbie

In general, in the immediate aftermath of natural disasters public officials face intense pressure to offer support, particularly to those households and businesses that for whatever reason are not insured (Boston and Lawrence, 2017). Public support for ad hoc assistance is bolstered by media coverage of natural disasters and can reinforce expectations that relief will be offered in similar situations in the future (Seifert et al., 2013). For example, immediately following the Edgecumbe floods caused by extratropical Cyclone Debbie in 2017, the prime minister, Bill English, acknowledged that 'there's probably going to be people there who aren't insured or for whom it's had a huge impact' and suggested that public assistance would be offered to households to work through 'their immediate issues and then if the long-term one is lack of insurance then we'll have to deal with that then' (Radio New Zealand, 2017). The government also offered a $700,000 support package to approximately 100 affected businesses (Morton, 2017), thereby creating a disincentive for businesses to purchase business continuity insurance for future events.

Public supply of residential insurance

The government believes it is important to help private property owners avoid 'socially unacceptable distress and loss in the event of a natural disaster' (New Zealand Treasury, 2015). EQC has helped ensure greater insurance penetration in New Zealand so that homeowners have a much higher take-up rate of catastrophe insurance than is the case in other countries (New Zealand Treasury, 2015).

EQC protects private residential property and contents from damage by earthquake, volcanic eruption, hydrothermal activity, landslip, tsunami, or fire caused by natural disaster. EQC land cover extends the range of perils to include storm and flood hazards, but excludes coastal erosion. EQC does not cover damage to residential structures or contents from storm or floods (or coastal erosion).

EQC premiums are collected by private insurance companies and are embedded within residential insurance policies that include fire insurance. Consequently, if private insurers withdraw from certain markets, homeowners would need to apply directly to EQC for cover. It is not clear how many homeowners would seek to do so and what administrative demands this would place on EQC and on its interactions with the private insurance sector. Retreat by private insurers from particular locations could increase the unfunded fiscal risk to the Crown associated with private property in natural disasters, should the Crown elect to provide relief to uninsured homeowners (ibid.).

Applying a standard (flat) EQC premium price nationwide helps spread the risk faced in more hazardous locations across all policy holders. This makes catastrophe insurance affordable for those who are most exposed and helps ensure high insurance penetration. In doing so, however, it also mutes the price signal which otherwise may discourage or shape development in more hazardous locations.

> EQC does not protect against erosion caused by slow-onset events or rising seas, but the courts may hold EQC liable for land loss caused by storms – many of which will be more destructive with sea level rise and changes in extreme precipitation.

The nature of EQC land cover is currently being reconsidered as part of the review of the Earthquake Commission Act 1993. There is, apparently, no current proposal to remove EQC's land cover for storms or floods (ibid.).[3]

In May 2017 the New Zealand government announced an increase to EQC's premiums (also known as the EQC levy), effective from 1 November 2017 (EQC, 2017). This increase was designed to ensure that the premiums paid by homeowners reflected EQC's long-term costs, including expected future losses from natural hazards. Historically, 85% of EQC's historical land claims have been less than $20,000 (New Zealand Treasury, 2015). Recent analysis commissioned by EQC assumes that the expected losses for EQC's land cover – for all perils – will remain less than 10% of EQC's total

average annual loss (New Zealand Treasury, 2017).

Except for severe liquefaction and major landslides, land damage from geological hazards can usually be remediated: volcanic ash can be removed and buckled earth can be levelled. EQC does not protect against erosion caused by slow-onset events or rising seas, but the courts may hold EQC liable for land loss caused by storms – many of which will be more destructive with sea level rise and changes in extreme precipitation. When land disappears with storm surges or flash floods, full compensation may be required. Given the rising value of coastal and riparian land, EQC's exposure could become orders of magnitude greater than historical averages.

Private supply of residential insurance

Insurance covers risks for which there is significant uncertainty. As such, insurers will retreat from coastal and riparian locations once risks are sufficiently probable. Insurers may retreat from a coastal or riparian area of New Zealand following a climate event in that location or in another New Zealand location. Alternatively, they may retreat after their experience in another country convinces them that risk profiles have changed because of sea level rise or other climatic changes. Insurance retreat from coastal and riparian locations could increase the unfunded fiscal risk faced by the Crown and decrease house prices as mortgages become unavailable (or more costly).

Insurers may be more willing to continue to provide insurance to high-risk areas if they decide to discriminate between these areas and lower-risk ones in the policies they offer (in premium prices, in excesses or in policy wording). Pressure to differentiate is likely to increase as the cost of estimating individual risk falls with higher-resolution climate models, advanced data aggregation and analysis ('big data') and the expansion of geodata such as LiDAR. Policy discrimination in New Zealand is uncommon and has historically taken the form of higher excesses rather than higher premiums, but this could change.

Impact of insurance retreat on mortgage availability and cost

Insurance is a requirement for residential mortgages in New Zealand and failing to maintain insurance can trigger 'technical' default. The possibility of default is exacerbated by maturity mismatches between residential insurance and mortgages. While mortgages are often granted with repayment periods spanning decades, insurance contracts are renewed annually. Insurers are thus able to leave an insurance market within 12 months, while it may be a decade or more before lenders' loans mature. As a consequence, in the future, bankers may lend to owners of coastal property less often, require more equity as collateral, or offer shorter mortgage terms (Lawrence et al., 2016). Even now, and despite their rules requiring mortgagors to insure, the general absence of compliance checks means that banks do not currently know whether particular properties they mortgage remain insured beyond the first year of ownership.

> As insurance retreats from particular locations, house prices in those areas are likely to be affected and infrastructure investments may be more difficult to justify.

Commercial insurance

The same problems and trends that we described for insurance for residential buildings and contents[4] also apply to commercial ones; though commercial cover responds to these pressures even faster. In New Zealand, since the 1993 Earthquake Commission Act, commercial properties are insured only by the private sector insurers. Without the involvement of the public insurer (EQC), the response of commercial policy premiums to the Canterbury earthquakes was more dramatic. The loss of cover for earthquake-prone buildings was more acute in the non-residential sector. It is also likely that some of the other factors that might be dampening the expected increases in premiums on individual residential properties do not apply in the commercial sector, where the full explicit and implicit risk is borne by the insurers.

For commercial properties, insurance plays an additional, socially beneficial role by allowing entrepreneurs and small and medium-size businesses to transfer some of the risks they incur, thus facilitating more investment in future activities and growth. The vast majority of businesses in New Zealand are small, so this risk-transfer role for insurance is potentially very important (though as yet unquantified). Similarly, business continuity insurance contracts are often tied to property insurance, so the potential withdrawal of commercial property insurance will impose cascading barriers on the operations of small and medium-size commercial entities.

Looking ahead

The landscape for insurance demand and supply is already changing. Insurers are gradually moving away from the New Zealand practice of all-peril policies. They are offering different types of maximum cover for different hazards, even though this adds complexity to insurance contracts. This may lower demand for disaster insurance from homeowners. A requirement that insurers provide a non-technical explanation of the key elements of the insurance policy on a single page could support homeowners' decision making. Reforms of consumer finance in the United States following the global financial crisis, such as the Credit CARD Act of 2009, provide an example of this type of requirement. A breakdown of the cost component for each category of risk – for example, how much of an insurance premium price covers the risk of fire as opposed to the risk of floods at that

location – could strengthen the signalling effect of insurance. From experience with other policies – for example, mandatory pricing of plastic bags – we know that even very modest pricing signals can have a material impact on behaviour.

As hazards become more likely, and particularly for homes experiencing repeat events, insurers are also transferring some risk back onto homeowners by requiring very high excesses. Insurers are already withdrawing from some individual flood- and earthquake-prone properties. Policymakers are limited in their ability to determine the extent of this problem, as private insurers do not disclose their commercial decisions regarding insurance availability. As climate hazards escalate, these trends will accelerate. In some jurisdictions, the insurance regulator collects information from insurers on insurance coverage (Plitt and Maldonado, 2012). Aggregated data from insurers on key contractual terms, including premium pricing and excess levels, and expected and actual losses, as well as notification of withdrawal of coverage from particular locations, could be very useful for policymakers in assessing emerging risks.

Insurance, which has long contributed to the financial security of homeowners and supported economic growth, will become less available. As insurance retreats from particular locations, house prices in those areas are likely to be affected and infrastructure investments may be more difficult to justify. Since insurance companies are unlikely to commit to long-term insurance contracts, local and central governments will need to commission their own analysis of the potential timing and scale of insurance retreat from locations affected by climate change hazards.

Furthermore, the New Zealand government's fiscal exposure will expand as the government faces ever greater pressure to respond to climate disasters with financial assistance and other post-event recovery support programmes. Creation of innovative funding instruments that support pre-event adaptation measures that enhance societal resilience and reduce risk could lessen these claims on central and local government when disasters occur (Boston and Lawrence, 2017).

Since climate change will render some currently inhabitable locations uninhabitable, policy interventions in the insurance market can only achieve so much. Projections of probable insurance retreat could serve as the canary in the coal mine, and inform decisions to gradually withdraw residential properties from those locations most at risk from climate change.

1 Economists, with their talent for esoteric terminology, call this myopia 'hyperbolic discounting'.

2 *Quake Outcasts* v *the minister of Canterbury earthquake recovery* [2017], NZCA 332 (1 August 2017).

3 EQC land liability is the smallest of: the area of the insured land that is damaged; the minimum-sized area allowed for use of a residential site under the relevant district plan; the value of the 4,000m2 closest to the dwelling (New Zealand Treasury, 2015).

4 Note: since private insurers do not provide cover for land damage, and EQC does not provide cover for commercial properties, no insurance is available for land damage on commercial properties.

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